Applications

Technical Report

Accuracy and precision of the epMotion system

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With the advent of the human genome era the molecular biology laboratory has once and for all changed from a small scale observatory into a semi-industrial, highly parallel environment with large numbers of samples and terabytes of processed data. The ever growing number of transcripts, genes, proteins and snips (SNPs) created great demand for high density formats and these are rather human unfriendly – our hands are very inaccurate and unreproducible equipment when it comes for dense repetitive grids, and are prone to the whole variety of errors.

Starting with the world-first adjustable microlitre pipette in early sixties Eppendorf has a long history in liquid handling and its products known for high quality, performance and precision, were always setting new trends in the laboratory practice. Also pipetting machines and liquid handling stations have a long legacy at Eppendorf: EPOS in seventies, ELAN in eighties and recently released, two state-of-the-art robotic platforms: epMotion 5070 and 5075. These two machines although different in size and having different functions have one important feature in common:

The pipetting heads of epMotion – or dispensing tools as we call them - employ the same technology Eppendorf has been successfully using for decades in our pipettes: air cushion piston stroke system with disposable high precision tips. This particular approach makes not only the exchange of dispensing tool child-easy but more importantly assures that the liquid handling is completely devoid of contamination (free jet) and can be performed in the large range of volumes (down to 1 µl) with high precision and accuracy (table 1).

But... is really a robot with disposable tips able to dispense so small amount of liquid as 1 µl in a free jet mode? Anyone who tried to do it with a pipette knows it is not that trivial task and precision is not perhaps the highest. Let's have a closer look at the epMotion dispensing tools data, are they really so precise as stated?

Tool	Range	Volume	Accuracy	Precision
TS 50	1-50 µl	1 µl	± 10%	< 5%
		50 µl	± 0.8%	< 0.4%
TS 300	20-300 µl	20 µl	± 4%	< 3%
		300 µl	± 0.6%	< 0.3%
TS 1000	40-1000 µl	40 µl	± 3%	< 2%
		1000µl	± 0.6%	< 0.2%

Table 1: Accuracy and precision data for the epMotion 5070/5075 dispensing tools. The data for the border volumes of the respective single channel tools (TS) is presented.

This makes hand pipetting rather inelegant for demanding and sensitive protocols like genotyping, quantitation of gene expression and larger scale sequencing.

Robotic stations therefore are preferred where highly repetitive pipetting in dense grids has to be performed with particular stress to speed, high accuracy and without danger of contamination – and Eppendorf by all means has taken these very prerequisites remarkably serious.
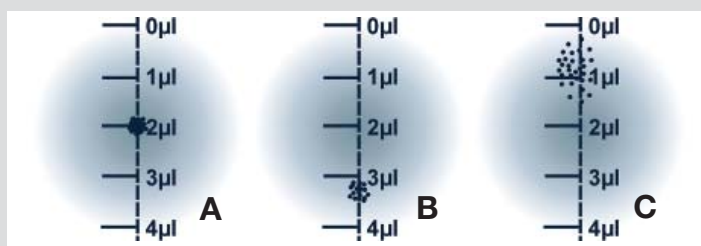
Fig.1: Explanation of the accuracy and precision terms. Nominal volume of 2 µl is dispensed (blue points) by exemplary tool with: A) high precision and high accuracy, B) high precision and low accuracy (far away from the nominal 2 µl), C) low precision and low accuracy (dispersed and far away from the nominal 2 µl).

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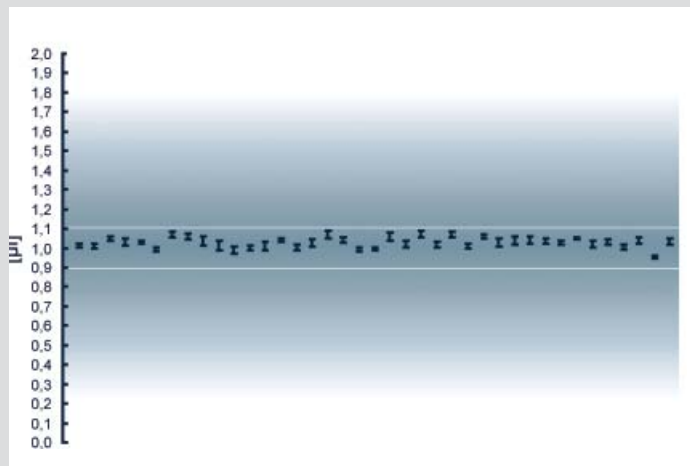
Fig. 2: Accuracy and precision of the epMotion single-channel 50 µl tools. Forty tools from different production lots were tested gravimetrically. Each point represents mean value of 10 single measured values for the given tool (in µl) and the error bars represent their precision. Border values for accuracy (+/- 10%) are indicated. Mean value is 1.025 µl. 82% of the tools have the accuracy of +/- 5%.

Forty single channel 50 µl tools (TS 50) were chosen from different production lots and tested gravimetrically which provides the most precise and direct measurement: set to the 1 µl nominal volume the weight of the free jet dispensed droplets was measured on a high-end precise scale in a strictly controlled, ISO-conformed laboratory environment. The results are summarised on the Figure 2. The official limit of accuracy for the TS50 is +/-10% meaning that no tool can dispense more than 1.1 µl and less than 0.9 µl in mean if set to the 1 µl nominal volume. All forty tools followed however much closer the nominal volume with the mean value of 1,025 µl! Closer look at the data reveals that more than 80% of tools have actually accuracy limits of 5%. This means that set to 1 µl a tool would actually vary not more or less than by 0.05 µl (a droplet of the 0.2 mm diameter!). And this accuracy is very precise: considerably higher than certified <5%. The forty tools tested here could pipette 1 µl with the mean precision of 3% meaning that average absolute variance for the 40 TS50 tools was between 1.055 µl and 0.995 µl (mean accuracy: 1.025 µl +/- 3%). The most indicative is however a practical evidence – directly from the scientific application: epMotion 5070 has been used to set up very sensitive real-time qPCR reactions. In the given example (Fig. 3), the viral load of the HBV in human serum samples was quantified. The highly coherent and repetitive intensity curves have been routinely obtained with much higher reproducibility than by hand-pipetting. Apart from highly reliable data the high performance of epMotion allows therefore to reduce the number of sample repetitions, reaction volume and in the end reagents usage – a factor with not small importance for the expansive, probe-based RT-qPCR systems.

And if high throughput means many samples – speed is required but not on the sake of reproducibility and precision:

Fast is fine, but accuracy is everything! (Wyatt Earp, the old west legendary gunslinger)
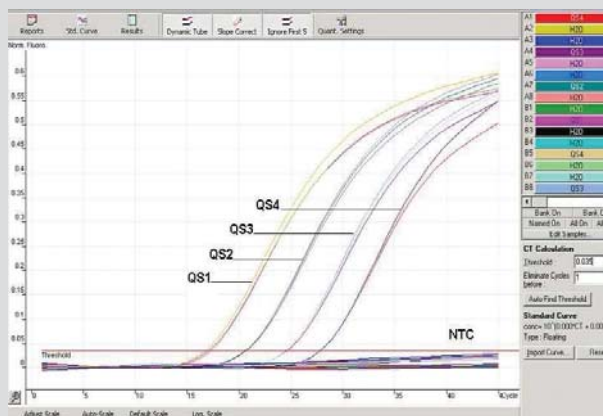
Fig. 3: A FAM channel for direct detection of the HBV-specific PCR product in human serum samples. Note the high reproducibility of the sample replicates and their coherence to the quantification standards (QS). No contamination was present. NTC: no template control.

Ordering information for epMotion accessories can be found at www.epmotion.com.

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